PAPERS

IN

CHEMISTRY.

N° I.

PORTABLE ELECTRO-MAGNETIC APPARATUS.

The LARGE SILVER MEDAL AND THIRTY GUINEAS *were this Session presented to Mr.* JAMES MARSH, *of Rush-grove-place, Woolwich, for a* PORTABLE ELECTRO-MAGNETIC APPARATUS, *which has been placed in the Society's Repository.*

EXCEEDINGLY interesting and important experiments on the intimate connexion between electricity and magnetism, mark the principal track of philosophical investigation during the last four years. Professor Oersted, of Copenhagen, led the way and was followed with zealous emulation by M. M. Ampère, Biot, and Arago, in France; by sir H. Davy,

Dr. Wollaston, Professor Cummings, Mr. Faraday, and Mr. Barlow, in England. The large and costly apparatus employed by most of these philosophers, necessarily restricted to a few persons placed in singularly favourable circumstances, the prosecution of these discoveries, and almost prevented the possibility of repeating the experiments on distant parts of the Earth's surface where the variation of terrestrial magnetism, as compared with that which takes place in our latitudes, may be expected to produce corresponding differences in the results. The mathematical laws of electro-magnetism as laid down by Mr. Barlow, however probable and consistent among themselves, would in particular derive great advantage from such investigations, as his theory of terrestrial magnetism already has, from experiments made by scientific officers on board his majesty's ships in different parts of the world.

Mr. Marsh, occupying a very subordinate department in the royal laboratory at Woolwich, was employed by Mr. Barlow as an assistant in his magnetic and electro-magnetic experiments. Thus favourably circumstanced, he was induced to turn his attention to the construction of an apparatus capable of exhibiting all the known facts of electro-magnetism, and of enabling the possessor to prosecute farther researches in this interesting and important branch of natural philosophy; while, at the same time, the portability of the apparatus and its moderate price, should place it within the purchase of most experimenters, and should peculiarly adapt it to the use of the traveller by land or sea. Having succeeded in his object, Mr. Marsh submitted his apparatus to the inspection and judgment of the Society, and before two numerous Committees, exhibited by means of it, with perfect success, all the facts of electro-magnetism which at that time had been discovered. The Society in recompence of the talents and ingenuity of the

inventor, voted to him the reward specified above, and directed the insertion, in the next volume of their Transactions, of a description of the apparatus, conceiving it likely to be useful to private individuals, and to be peculiarly well adapted for service on board ship, in some of those naval expeditions for the promotion of science and general knowledge which so honourably characterize the present Board of Admiralty.

The whole apparatus is included in a box 14½ inches high, 15 inches broad, and 10½ inches wide, which when folded out forms a convenient table for the operator. Plate I, fig. 1, is a perspective view of the box ready for use, the flap *a* being raised up and supported by the leg *b*, which screws into it. The voltaic battery, with its appendages, occupies about half the box, and consists of a plate of copper, with a plate of zinc on each side. Figs. 3 and 4 are a front and transverse view of the battery; the two exterior or zinc plates are united at each corner by metal fastenings, and the intermediate or copper plate is cut away at the corners just sufficiently to prevent it from contact with the fastenings of the zinc plates, and is secured in its position by pieces of wood; *i i* are two copper feet upon which the battery rests when in action. Two brass pipes C and Z are soldered, the former to the copper plate, the latter to one of the zinc plates; they are intended to hold a little mercury for the purpose of forming a perfect connexion between the conductors C and Z, fig. 1, and the battery; in order still farther to secure the connexion, the ends of the conductors that are inserted into the pipes are first tinned and afterwards amalgamated, as well as the other ends on which the spiral wires, fig. 18, forming the poles of the battery, are fixed. The battery when not in use is lodged in the cell *e*, figs. 1, 2, which is lined with wood and varnished; the two jointed handles, by means of which it is raised, being laid

down into notches cut in the partition between the two cells. The cell *d* is somewhat wider than the other, and is lined with sheet copper: into this the exciting fluid (dilute muriatic acid) is poured when the battery is intended to be put into activity, and the united copper and zinc plates being raised, by means of the two handles, out of cell *e*, are to be gently let down into the fluid, resting on the bottom of cell *d*, by means of the two copper feet *i i*, already mentioned. By this arrangement the battery forms a series of three copper and two zinc plates, the lining of the cell forming the two exterior copper plates, and consists of about eight square feet of metallic surface. Two pieces of varnished wood *g h*, fig. 2, are fixed to the sides of the cell to prevent the zinc plates from coming in contact with its copper lining. A small tray *f*, fig. 2, is placed on the flap *a*, in order to retain any fluid which may be accidentally spilled during the experiment.

Fig. 5, shows the general arrangement of that part of the box, covered by flap *a*, fig. 1, in which the different articles of apparatus are deposited. The lowest compartment, represented more at large fig. 6, contains a pair of horse-shoe magnets, a cylindrical magnet, a pocket compass, some spare copper wire, and two tin boxes, in one of which are contained iron filings, in the other spiral wires of iron, tinned and amalgamated. Over this is placed the lower shelf, figs. 7 and 8; the under projections of which secure in their places the articles already mentioned. The three upper shelves, figs. 10, 11, 12, are cut out in the forms represented, in order to admit in the most secure and compact manner, the various pieces of apparatus described and figured in Mr. Barlow's 'Treatise on Electro-magnetism, to which the reader is referred. Three, however, of these pieces of apparatus being the original invention of Mr. Marsh, are here represented.

Figs. 13 and 14 are the view and section of a central cylindrical magnet, having an agate socket inserted in each pole; on this socket rests a pivot having two branches of wire, by means of which, a hollow cylindrical cup of copper is suspended. In the copper cup is placed a cylinder of zinc also suspended by two wire branches, and balanced on the pivot *k*, which has free motion in a socket fixed on the wire by which the copper cup is suspended. Some dilute acid being placed in the copper cup, voltaic action is excited, and the copper cup will revolve slowly in one direction, while the zinc cylinder moves round in the opposite direction. By supporting this apparatus on the other pole of the central magnet, the motions of the copper and zinc will be reversed.

Fig. 15 exhibits a glass tube closed at its lower end, and passed through a circular piece of cork for the purpose of floating it, a voltaic combination is contained in the tube with which the spiral wire *l l* communicates; dilute acid being put into the tube, and the whole apparatus being floated in water, the spiral wire will place itself North and South in the same manner as a common magnetic needle will.

Fig. 16 is a stand with a long narrow reservoir for mercury, out of which rises a metallic pillar which supports a fine wire attached by a loop to the eye *m*: the lower end of the wire dips in the mercury, and, as well as the upper end, is amalgamated in order to render the contact more compleat. A horse shoe magnet is then laid with a pole on each side of the trough, and as soon as the voltaic circuit is compleated, by means of the cups *n* and *o* filled with mercury, the moveable wire continues to leap out of the mercury, and to fall into it again in the direction indicated by one of the dotted lines. On

reversing the poles of the magnet, the former motions will cease, and others similar to them will take place in the direction of the other dotted line.

N° II.

MELTING POTS.

The LARGE SILVER MEDAL *was this Session presented to Mr.* HENRY MARSHALL, *of Newcastle on Tyne, for his improved Melting Pots for Brass Founders and other workers in Metal. Samples of the Pots are placed in the Society's Repository.*

LARGE earthenware crucibles (technically called melting pots) are used in great quantities by brass founders, steel melters, and other workers in metal. They are made in London, Birmingham, Sheffield, and other places; and their ingredients are tenacious refractory clay, together with fragments of earthenware made of the same or similar clay, reduced to powder more or less coarse according to the experience of the manufacturer. It is not necessary that they should be possessed of the highest degree of refractoriness, since the heat to which they are exposed is not so great, nor are the fluxes employed by the founders so active, as are necessary for the reduction of metallic ones to their reguline state. But it is especially expedient that they should be capable of enduring